

of pale spots on scutellum. I am inclined to regard *basilaris* and *tuberculatus* as synonymous, however.

21. **Nysson basilaris** Cress.

Nysson basilaris CRESSON, Tr. Am. Ent. Soc. IX, p. 281, ♀.
Georgia.

22. **Nysson bellus** Cress.

Nysson bellus CRESSON, *ibid.* p. 280, ♀.
Montana and Texas.

23. **Nysson pumilus** Cress.

Nysson pumilus CRESSON, *ibid.* p. 405, ♂.
Nevada.

24. **Nysson albomarginatus** Cress.

Nysson albomarginatus CRESSON, *ibid.* p. 278, ♂ ♀.

Nevada. Easily distinguished by the pale, continuous fasciæ of abdomen. The unique ♀ type has also two, tranverse, pale spots on first segment, near base. These may not be constant in a series, however.

25. **Nysson mæstus** Cress.

Nysson mæstus CRESSON, *ibid.* p. 280, ♂.
Washington State.

26. **Nysson bicolor** Cress.

Hyponysson bicolor CRESSON, *ibid.* p. 284, ♀.
Nysson bicolor HANDLIRSCH, l. c. p. 402.

Washington State. The unique type of this species lacks the third submarginal cell.

SOME NOTES ON LOCUST STRIDULATION.

By A. P. MORSE, Wellesley, Mass.

Every observer of outdoor Nature is familiar to a greater or less extent with the peculiar rattling or crackling sounds produced by certain locusts or "grasshoppers" in flight. When at rest these insects are quite inconspicuous, their colors resembling closely the prevailing tints of their surroundings, but when in flight many of them attract notice not only by their stridulation, but also by their strikingly colored wings in which yellow and red with black markings predominate.

These locusts belong to a group, the *Cedipodinæ*, usually given subfamily rank, of which fifteen species are found in New England. One of the best known and most widely distributed of these in eastern North America is a species whose wings are black with a pale buff outer border and with a few spots at the tip; this is the Carolina locust. It is very common on dusty roadsides and waste places in the latter part of summer and the early autumn. Owing to the prevailing tint of quiet brown which clothes the majority of individuals they are known in some localities as "Quakers."

Just how the rattling sound is produced is a matter of some speculation; it is, however, entirely under the control of the insect, which can produce it or not at will. So far as recorded, only the male stridulates, though I suspect that the females of some species occasionally do in a less degree. Owing to the noise being produced in flight it is difficult not only to observe the exact method of its production, but also to determine with certainty that it is confined to one sex. It is usually stated to be caused by the striking of the front edge of the wing against the under side of the wing-cover. This might occur as the result of an up-and-down blow or, as I venture to suggest, of a slight antero-posterior movement bringing the prominent veins of the under side of the wing-cover (humeral trunk and ulnar or anal veins) into collision with the raised veins of the base of the wing.

Certain species, however, produce not only rattling, but distinct snapping sounds consisting of separate loud snaps or clacks, *e. g.*, *Circotettix verruculatus*, which often dances up and down in the air while doing so and not infrequently ends its powerful and erratic flight with a rattle immediately before alighting. It has seemed to me that the clacks may be produced in a different manner from the rattling sounds, and the following is suggested as a possible explanation.

If the wing-cover of any of our larger *Cedipodinæ* be examined there will be readily seen near its point of attachment, about in its midline, between the bases of two of the conspicuous veins (humeral trunk and anal) and pressing them apart, as it were, a distinct prominence. From this spring the two ulnar veins. If the wing-cover be inverted a depression will be found corresponding to the external prominence. In this depression lies the elevated base of the median vein of the wing when the wings and wing-covers are closed, and this arrangement holds these organs in place in the position of rest without any direct effort of the insect. If the wing-cover of a newly killed or relaxed *Cedipodine* be properly manipulated it will leave its place with a distinct snap, due

to the sudden slipping off of the base of the wing-cover from the base of the wing. This arrangement is highly developed in the genus *Circotettix*, whose members are noted for the clacking noise produced in flight, which it seems to me may perhaps be thus produced by the sudden, and more or less rapidly repeated, opening and closing of the flight-organs.

There is another group of locusts found with us, fewer in species, smaller in size, and of less conspicuous habits, but more plentiful in numbers than the *Edipodinæ*, which stridulate not during flight, but when at rest,—these are the little oblique-faced *Tryxalinæ*. In this group the sound is produced by rubbing the hind thighs against the wing-covers, and both the apparatus and its working are readily observed. It consists, in most of our species, of a row of fine teeth projecting from the inner side of the hind thighs of the male in such a position as to engage the elevated veins of the basal part of the wing-covers, by this means setting up vibrations in the latter. This may be readily demonstrated in the fresh insect or a relaxed specimen. The sounds produced in this way are entirely different in character from those made by the *Edipodinæ* in flight, being a scraping or scratching, as distinguished from a rattling, crackling, or rustling.

There is, however, a genus (*Mecostethus*) of this group which is allied to the *Edipodinæ* in structure, and the males of one of its species produce the loudest note made by any of our *Tryxalinæ*. In this genus the hind thighs of the males are destitute of teeth, which are borne instead upon a supernumerary vein of the wing-covers, which is raised above the others. In the species referred to the teeth on this vein are high and very acutely pointed.

This additional vein is found in all our representatives of the *Edipodinæ*, which stridulate in flight, and the discovery of this arrangement of the apparatus in *Mecostethus* led me to examine this vein in several species of *Edipodinæ* to see whether it was ever supplied with a rasping surface; for if so, these locusts also could doubtless stridulate when at rest. It was found in several species to be provided with teeth of different degrees of effectiveness, and not long afterward I was enabled to witness the use of this form of stridulating apparatus by an *Edipodine*.

While walking up the Mt. Washington carriage-road one bright morning in early September I came upon a group of several males of *Circotettix verruculatus* sunning themselves by the roadside in the shelter of an overhanging cliff. The night had been quite cool and

they had evidently but just become sufficiently warmed by the morning sun to take an active part in life, and in consequence allowed a closer approach than is the usual custom of this wary species. Two of them seemed more wide awake than the others, and as they crawled about would occasionally stop, slightly elevate the hinder part of the body and rapidly move the hind thighs up and down against the wing-covers, producing a distant "scratching" sound clearly audible at a distance of three or four feet. This act was repeated several times at intervals of a few seconds. No females were seen near by.

Desiring to make further observations on this mode of stridulation in the *Cedipodinae* I secured one day after my return several examples of *Encoptolophus sordidus* and *Arphia xanthoptera* and enclosed them, together with some grass, in a pasteboard box of about a cubic foot capacity, covered it with netting and placed it in the sun. Both sexes of both species were represented, but of females there were but two of each.

At first their efforts were entirely in the direction of escape, but after a short time they became more quiet and were left by themselves, an occasional approach being made to see how matters stood. Nothing of interest was learned from the *Arphias*, but after some time two males of *E. sordidus*, oblivious to their surroundings, became attentive to one of the females. Aroused by her near presence they crawled rapidly about, and as they approached her would stop, stridulate for a second with their hind thighs, and excitedly leap toward or upon her, when, being repulsed, they would repeat the operation. The sound produced was a very high-pitched "i'chĩ-i'chĩ-i'chĩ-i'chĩ."

Another sound of an entirely different character was made by them in a different manner. The hind thighs, instead of being closely applied to the wing-covers, were spread somewhat apart and violently vibrated, moving, as nearly as could be judged, up and down with extreme rapidity and striking as they did so upon the bottom of the box. The sound produced was a peculiar "r-r-r-rd" or "r-r-r-rt," low in tone and of considerable volume, leading me to think from its quality that it was due in part to the vibration of the pasteboard bottom. Once it seemed as if the wing-covers took some part in it, vibrating laterally; but as the act was witnessed but twice, both times from the side, and was too rapid for the eye to follow, I am uncertain of the exact method of its production.

Lack of time in suitable weather prevented further observations, but these are reported in the hope of bringing out information on the subject and inducing other observers to pay some attention to this interesting habit.

The occurrence in the *Cedipodinæ* of stridulation when at rest seems to have been entirely overlooked in late years, though observed by Yersin in *Ced. fasciata*. Among the *Acridinæ* *Caloptenus italicus* and *Melanoplus femur-rubrum* have been observed by Yersin and Scudder respectively to perform the stridulatory movements, though no sound was noted in either case. Yersin was disposed to believe that all locusts provided with well-developed wing-covers execute such movements, whether accompanied by sound or not. And it is not unlikely that sound is often produced too faint or fine for our ears to perceive.

Nothing is known of stridulation in the *Tettiginæ*, but it seems possible that it may occur in the same manner, *i. e.*, by friction of the hind thighs on the side of the pronotal process or anterior edge of the wing which in this group take the place of the wing-covers. In the *Eremobinæ* both sexes are said by Saussure to be often provided with special musical apparatus of two kinds, one used at rest and one in flight and both differing from those here mentioned.

BOTH SIDES OF BUTTERFLIES.

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Every collector of butterflies and every student of variation in these insects is interested in methods whereby both surfaces of the wings of his favorites can be studied with a minimum amount of labor and inconvenience. Book-boxes, so-called, with glass top and bottom and cork gummed to the glass, answer very well in a permanent collection, but for one which is receiving additions and to whose owner expense is an item to be closely considered, so that an entire case or cases cannot be given up to a species, some method is necessary which will more readily permit of rearrangement when desired. With this end in view I several years ago designed the following plan, which is here presented in the hope that it will be of interest or use to others. While metal strips filled with cork have been used for some time I believe that the method of rearrangement suggested is entirely novel.

The cases for which the plan was designed are of the standard museum pattern, 16 x 19 x 3 inches outside, 15 x 18 inside measurement, the top and bottom of glass, the sides of wood joined by tongue and groove, the tongue being either of wood or metal. The plan, however, is applicable to almost any form or size of case preferred. Aside from